Conceptualizing the Water Management System with UML

Iterative Development Process

- Apply an **iterative development process** (IDP) widely used to create commercial software
  - Use exercises to define actors, their responsibilities, and their interactions
  - Keep it simple, do only what is required to reach understanding
  - Leads to system requirements
  - Supports creation of adaptive software

Phases in IDP

- Analyze – what are the questions we want to answer and what are the key components needed to answer it?
- Design – how might we represent our conceptual model of the actual system using math and software constructs?
- Implement – "code" design in a software development environment

IDP Basic Steps

- Define Use Cases
- Define Conceptual Model
- Define Interaction Diagrams
- Define Design Class Diagrams
- Implement in small steps and test frequently

Graphical Modeling Notation

Unified Modeling Language (UML)

What is UML?

- The Unified Modeling Language is a visual language for specifying, constructing and documenting artifacts of systems
- It is the de facto standard diagramming notation for drawing or presenting pictures related to object-oriented software
- Can be complicated but we are keeping it simple

No Silver Bullet

- UML is simply a standard diagramming notation – boxes, lines, etc.
- Visual modeling with common notation can be helpful
- Does not replace the need for system knowledge and sound design skills
- Just as a word processor does not write, UML does not analyze or design

How Have We Used UML?

- As a sketch tool during interactive conceptual modeling of an actual system of interest (e.g. predicting urban water demand)
- To illustrate how existing analytical tools work (e.g. Urban Water Use Model)
- To help create new software implementations

DEPARTMENT OF WATER RESOURCES
STATE OF CALIFORNIA

3 Basic UML Artifacts

- Use case
  - Narrative description of intended use of the software
- Class diagram
  - Properties of each object and relationships between objects
- Sequence diagram
  - Dynamic view of interaction between objects

Urban Water Use

Applying Object-Oriented Techniques and UML to Document DWR Process

Estimate Water Use in a Study Area

Goal Level: Sea Level

Main Success Scenario:

1. Planner sends water use survey forms to public water systems and commercial and industrial water users.

2. Public water systems and commercial and industrial water users complete survey forms and send them to data entry

3. Data entry converts survey data to digital format

4. Data entry sends digital survey data to QA/QC.

5. QA/QC conducts quality control/quality assurance process

6. QA/QC sends digital data to Urban Water Use Model

7. Planner requests demographic data for study area from demographer

8. Demographer processes demographic data for study area

9, Demographer sends demographic data to Urban Water Use Model

10. Planner runs Urban Water Use Model

11. Planner reviews Urban Water Use Model output

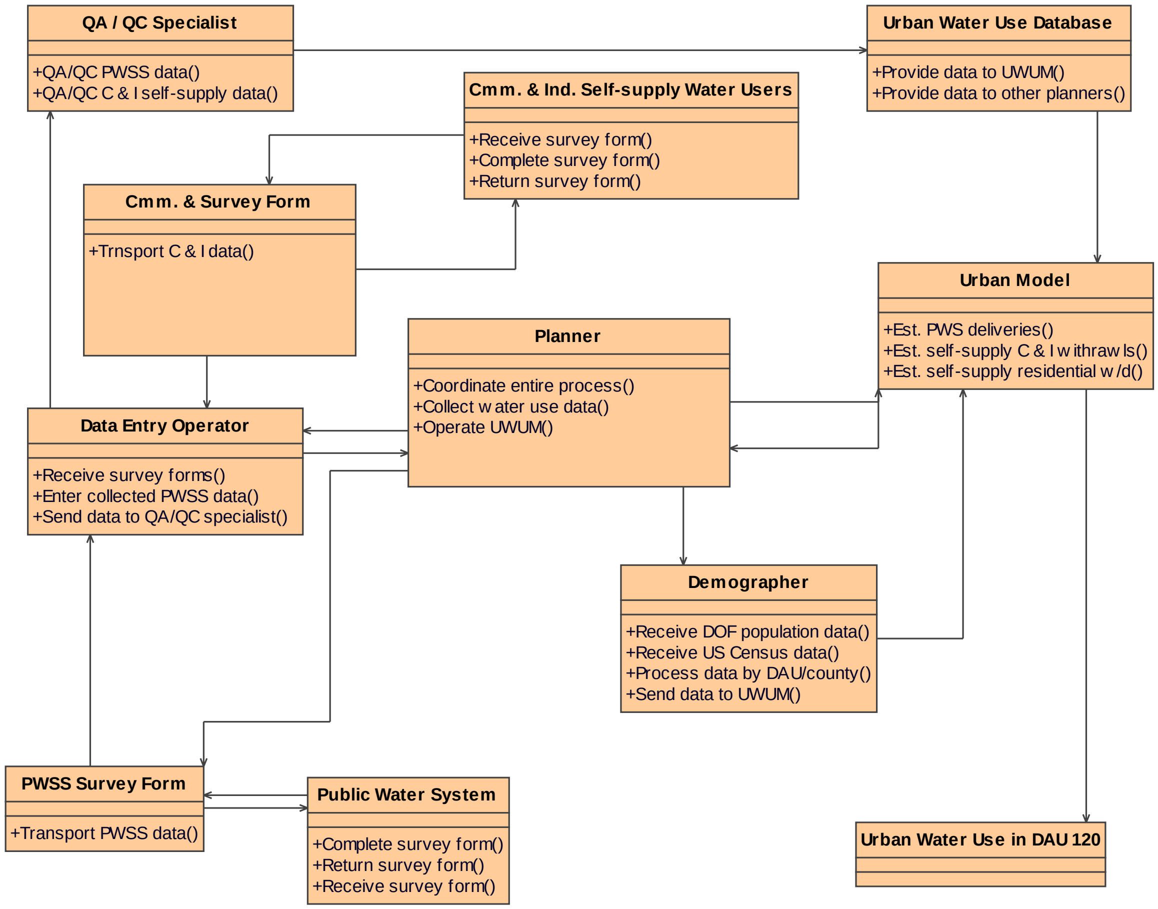
12. Urban Water Use Model outputs is taken as estimate of urban water use in study area

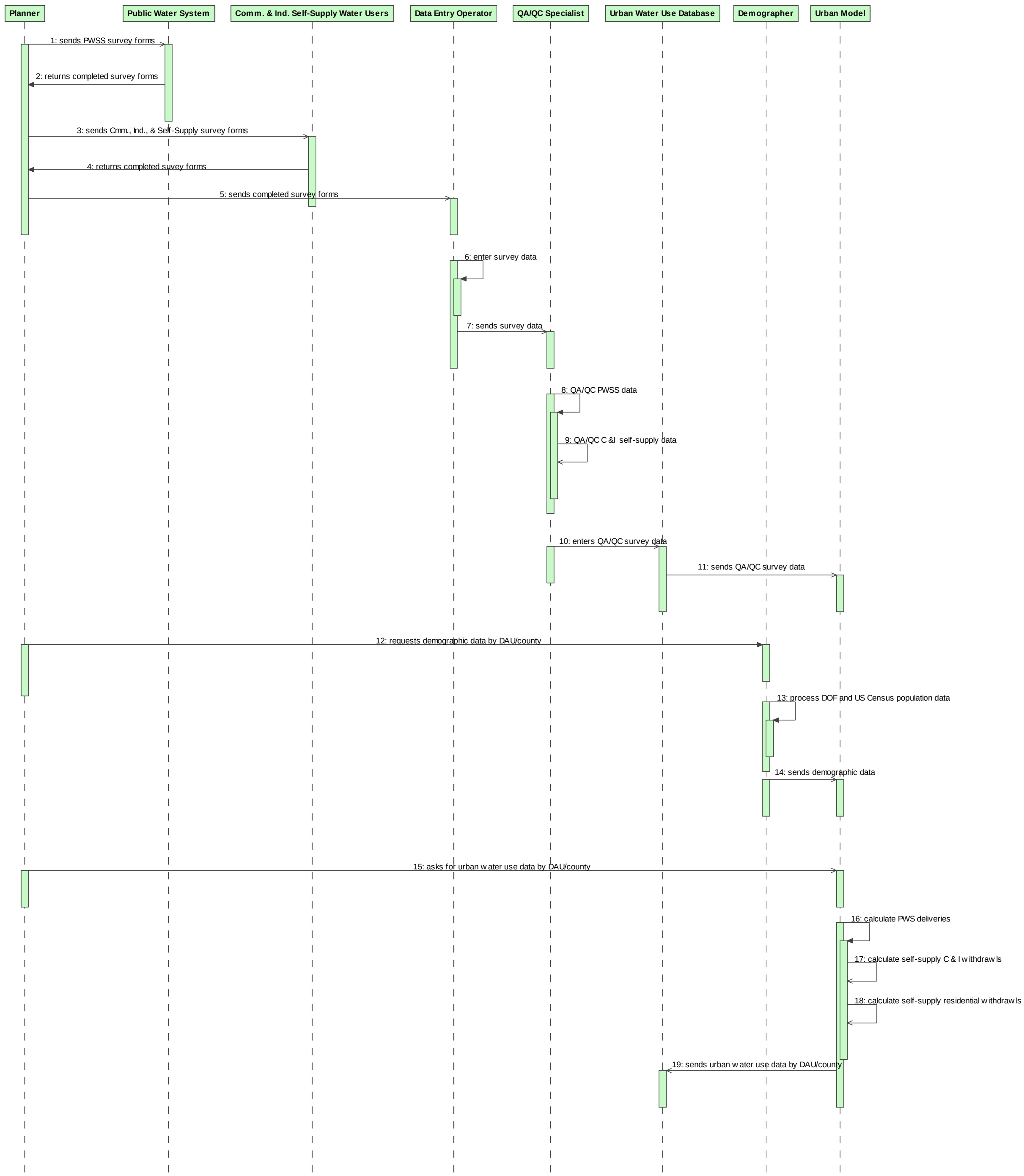
Extensions

10a: Urban Water Use Models fails to run

.1 Planner checks for missing and invalid input data

.2 Planner inputs missing data or corrects invalid data, returns to MSS at step 10


QA / QC Specialist
+QA/QC PWSS data()
+QA/QC C & I self-supply data()
Urban Water Use Database
+Provide data to UWUM()
+Provide data to other planners()
Cmm. & Ind. Self-supply Water Users
+Receive survey form()
+Complete survey form()
+Return survey form()
Cmm. & Survey Form
+Trnsport C & I data()
Urban Model
+Est. PWS deliveries()
+Est. self-supply C & I w ithraw ls()
+Est. self-supply residential w /d()
Planner
+Coordinate entire process()
+Collect w ater use data()
+Operate UWUM()
Data Entry Operator
+Receive survey forms()
+Enter collected PWSS data()
+Send data to QA/QC specialist()
Demographer
+Receive DOF population data()
+Receive US Census data()
+Process data by DAU/county()
+Send data to UWUM()
PWSS Survey Form
+Transport PWSS data()
Public Water System
+Complete survey form()
+Return survey form()
+Receive survey form()
Urban Water Use in DAU 120


Planner
Public Water System
Comm. & Ind. Self-Supply Water Users
Data Entry Operator
QA/QC Specialist
Urban Water Use Database
Demographer
Urban Model
1: sends PWSS survey forms
2: returns completed survey forms
3: sends Cmm., Ind., & Self-Supply survey forms
4: returns completed suvey forms
5: sends completed survey forms
6: enter survey data
7: sends survey data
8: QA/QC PWSS data
9: QA/QC C&I self-supply data
10: enters QA/QC survey data
11: sends QA/QC survey data
12: requests demographic data by DAU/county
13: process DOF and US Census population data
14: sends demographic data
15: asks for urban water use data by DAU/county
16: calculate PWS deliveries
17: calculate self-supply C & I withdrawls
18: calculate self-supply residential withdrawls
19: sends urban water use data by DAU/county

Use Case 2

Use Case - Water Use by Customer Classes in a DAU
Goal Level: Sea Level

Main Success Scenario:

1. User starts the California Urban Water Use Model
   The User Interface displays the Main Interface;

2. User imports PWSS data of the year of interest
   Route: Main Interface \ Import.
   Choose a year from pull down list to match the year of the data. Click Import. A new window pops up which let the user navigate to the data folder. Input Class ensures the integrity of the imported data. Data Base Class creates a new table to host the newly imported data. Click Done to go back to the main interface.

3. User adds the population of the DAU-County of the year of interest
   Population data should be added to the table named "tblDAUCountyYears"

4. User QA/QC imported PWSS data
   Route: Main Interface \ Input... \ Public Water System (PWS) System.
   Choose a Year. Choose a PWS to inspect. The user can correct errors by directly typing in the correct info or number. The user can also choose to override the imported data by choosing one of two override check boxes, Override Production and Delivery Values or Override Delivery Values only

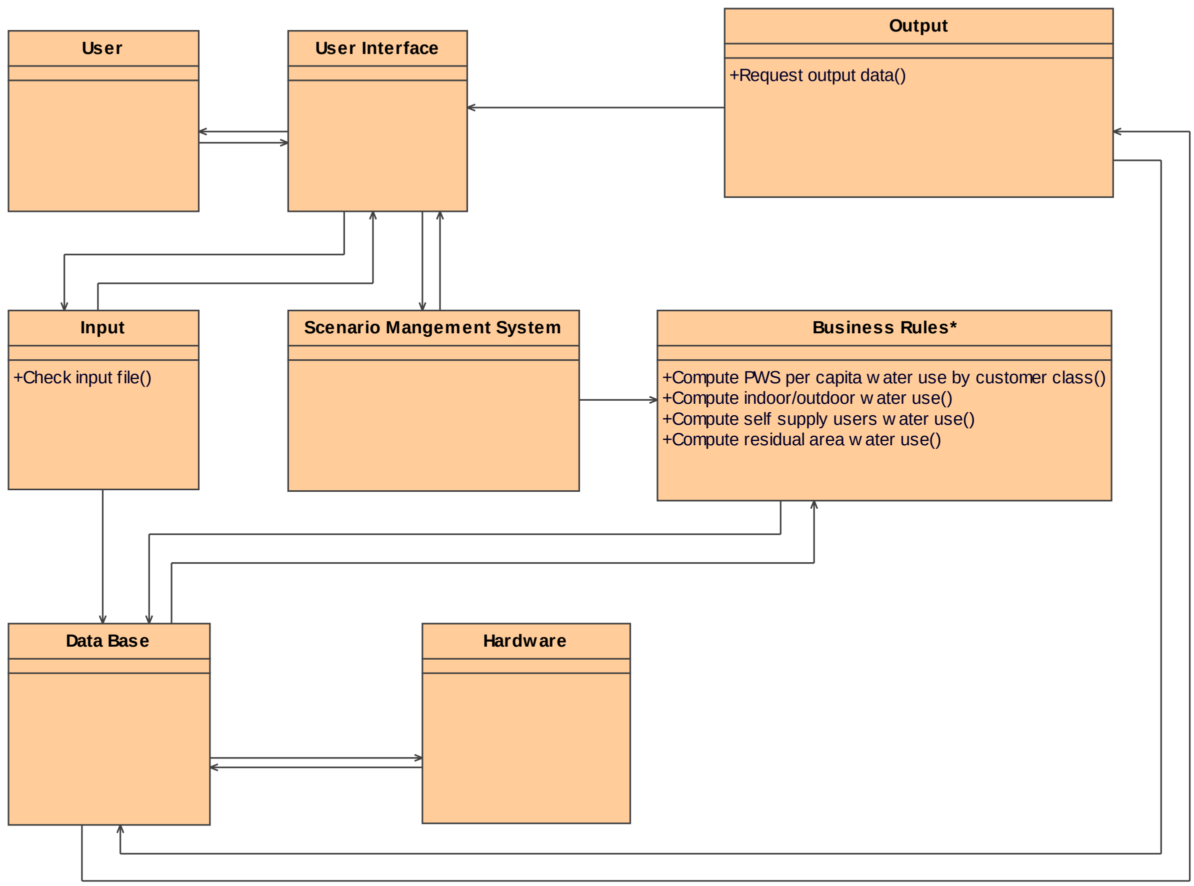
5. User enters DAU-Counties where PWS resides
   Route: Main Interface \ Input... \ Public Water System (PWS) System.
   Under tab General, click Add New to enter all the DAU-Counties where PWS resides and the PWS population residing in each of the DAU-Counties. The same info and values can also be entered using,
   Route: Main interface \ Input \ PWS Sub Groups.
   User identifies all PWSs within the DAU-County, and enter the same population value.

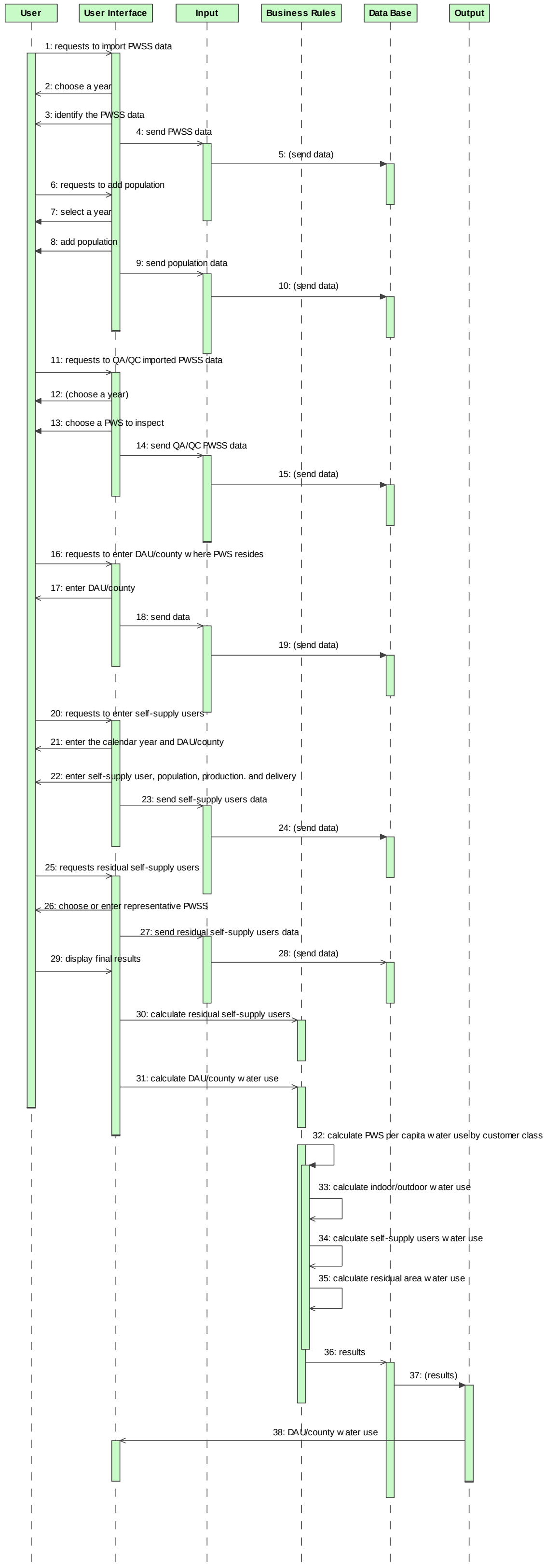
6. User enters Self Supply Users
   Route: Main interface \ Input \ Self Supply Users
   Choose a Year, DAU-County, and Self Supply User. Click on Add New to add Production and Delivery.

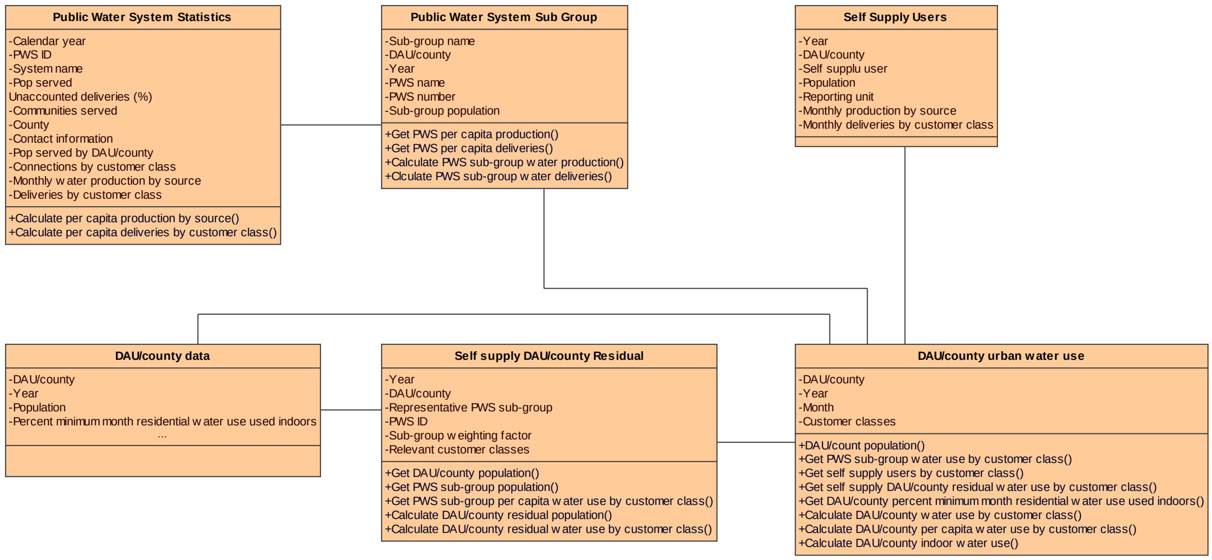
7. User chooses representative PWSs for residual self supply users
   Route: Main interface \ Input \ DAU County Data
   The default representative PWSs used to calculate residual self supply users are PWS subgroups within the boundary of the DAU-County. User can also select the check box of Override Representative Residual PWS data to type in new data to represent the residual self supply users.

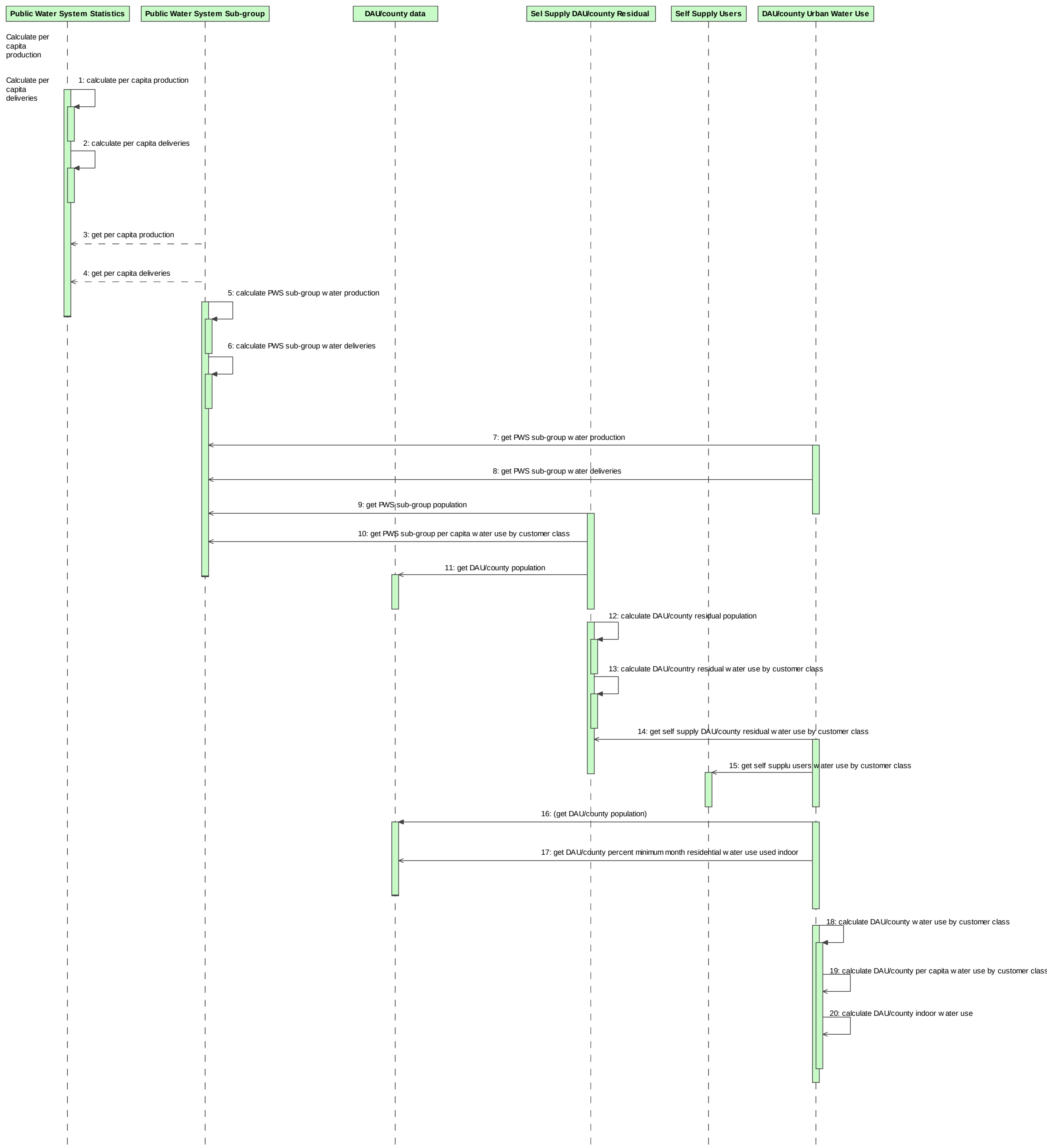
8. User requests to show final results
   Route: Main interface \ Reports... \ DAU-County Deliveries

9. System provides the final results
   System shows monthly water deliveries of all customer classes for each DAU-County. User can query this table to narrow to the data needed.


User
User Interface
Output
+Request output data()
Input
+Check input file()
Scenario Mangement System
Business Rules*
+Compute PWS per capita w ater use by customer class()
+Compute indoor/outdoor w ater use()
+Compute self supply users w ater use()
+Compute residual area w ater use()
Data Base
Hardware


User
User Interface
Input
Business Rules
Data Base
Output
1: requests to import PWSS data
2: choose a year
3: identify the PWSS data
4: send PWSS data
5: (send data)
6: requests to add population
7: select a year
8: add population
9: send population data
10: (send data)
11: requests to QA/QC imported PWSS data
12: (choose a year)
13: choose a PWS to inspect
14: send QA/QC PWSS data
15: (send data)
16: requests to enter DAU/county where PWS resides
17: enter DAU/county
18: send data
19: (send data)
20: requests to enter self-supply users
21: enter the calendar year and DAU/county
22: enter self-supply user, population, production. and delivery
23: send self-supply users data
24: (send data)
25: requests residual self-supply users
26: choose or enter representative PWSS
27: send residual self-supply users data
28: (send data)
29: display final results
30: calculate residual self-supply users
31: calculate DAU/county water use
32: calculate PWS per capita water use by customer class
33: calculate indoor/outdoor water use
34: calculate self-supply users water use
35: calculate residual area water use
36: results
37: (results)
38: DAU/county water use


Public Water System Statistics
-Calendar year
-PWS ID
-System name
-Pop served
Unaccounted deliveries (%)
-Communities served
-County
-Contact information
-Pop served by DAU/county
-Connections by customer class
-Monthly w ater production by source
-Deliveries by customer class
+Calculate per capita production by source()
+Calculate per capita deliveries by customer class()
Public Water System Sub Group
-Sub-group name
-DAU/county
-Year
-PWS name
-PWS number
-Sub-group population
+Get PWS per capita production()
+Get PWS per capita deliveries()
+Calculate PWS sub-group w ater production()
+Clculate PWS sub-group w ater deliveries()
Self Supply Users
-Year
-DAU/county
-Self supplu user
-Population
-Reporting unit
-Monthly production by source
-Monthly deliveries by customer class
DAU/county data
-DAU/county
-Year
-Population
-Percent minimum month residential w ater use used indoors
...
Self supply DAU/county Residual
-Year
-DAU/county
-Representative PWS sub-group
-PWS ID
-Sub-group w eighting factor
-Relevant customer classes
+Get DAU/county population()
+Get PWS sub-group population()
+Get PWS sub-group per capita w ater use by customer class()
+Calculate DAU/county residual population()
+Calculate DAU/county residual w ater use by customer class()
DAU/county urban water use
-DAU/county
-Year
-Month
-Customer classes
+DAU/count population()
+Get PWS sub-group w ater use by customer class()
+Get self supply users by customer class()
+Get self supply DAU/county residual w ater use by customer class()
+Get DAU/county percent minimum month residential w ater use used indoors()
+Calculate DAU/county w ater use by customer class()
+Calculate DAU/county per capita w ater use by customer class()
+Calculate DAU/county indoor w ater use()


Public Water System Statistics
Public Water System Sub-group
DAU/county data
Sel Supply DAU/county Residual
Self Supply Users
DAU/county Urban Water Use
Calculate per capita production
Calculate per capita deliveries
1: calculate per capita production
2: calculate per capita deliveries
3: get per capita production
4: get per capita deliveries
5: calculate PWS sub-group w ater production
6: calculate PWS sub-group w ater deliveries
7: get PWS sub-group w ater production
8: get PWS sub-group w ater deliveries
9: get PWS sub-group population
10: get PWS sub-group per capita w ater use by customer class
11: get DAU/county population
12: calculate DAU/county residual population
13: calculate DAU/country residual w ater use by customer class
14: get self supply DAU/county residual w ater use by customer class
15: get self supplu users w ater use by customer class
16: (get DAU/county population)
17: get DAU/county percent minimum month residential w ater use used indoor
18: calculate DAU/county w ater use by customer class
19: calculate DAU/county per capita w ater use by customer class
20: calculate DAU/county indoor w ater use